

We claim:

- 5 1. A process for preparing butadiene from n-butane comprising the steps of
- (A) providing an n-butane-containing feed gas stream,
- (B) feeding the n-butane-containing feed gas stream into a first dehydrogenation
10 zone and nonoxidatively catalytically dehydrogenating n-butane to 1-
 butene, 2-butene and optionally butadiene to obtain a first product gas
 stream comprising n-butane, 1-butene and 2-butene, with or without
 butadiene and secondary components,
- 15 (C) feeding the first product gas stream comprising n-butane, 1-butene and 2-
 butene, with or without butadiene and secondary components, into a second
 dehydrogenation zone and oxidatively dehydrogenating 1-butene and 2-
 butene to butadiene to give a second product gas stream comprising
 butadiene, n-butane and steam, with or without secondary components,
- 20 (D) recovering butadiene from the second product gas stream.
2. The process as claimed in claim 1, wherein the provision of the n-butane-containing
 feed gas stream comprises the steps of
- 25 (A1) providing a liquefied petroleum gas (LPG) stream,

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(A2) removing propane and optionally methane, ethane and pentanes from the LPG stream to obtain a butane-containing stream,

(A3) removing isobutane from the butane-containing stream to obtain the n-butane-containing feed gas stream and optionally isomerizing the removed isobutane to an n-butane/isobutane mixture and recycling the n-butane/isobutane mixture into the isobutane removal.

3. The process as claimed in claim 1 or 2, wherein the nonoxidative catalytic dehydrogenation (B) of n-butane is carried out as an autothermal catalytic dehydrogenation.

4. The process as claimed in any of claims 1 to 3, wherein the oxidative dehydrogenation (C) is carried out in more than one stage.

5. The process as claimed in any of claims 1 to 4, wherein the recovery (D) of butadiene from the second product gas stream comprises the steps:

(D1) cooling the product gas stream with water to condense out steam and any high-boiling organic secondary components;

(D2) removing the low-boiling secondary components contained in the second product gas stream which are selected from the group consisting of hydrogen, carbon monoxide, carbon dioxide, nitrogen, methane, ethane, ethene, propane and propene, to obtain a stream comprising butadiene and n-butane, with or without 1-butene and 2-butene, and with or without oxygenates as further secondary components;

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(D3) optionally removing the oxygenates to obtain a stream comprising butadiene and n-butane, with or without 1-butene and 2-butene;

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(D4) separating the stream comprising butadiene and n-butane, with or without 1-butene and 2-butene, into a stream comprising n-butane, with or without 1-butene and 2-butene, and a stream comprising butadiene;

(D5) optionally recycling the stream comprising n-butane, with or without 1-butene and 2-butene, into the nonoxidative catalytic dehydrogenation (B).